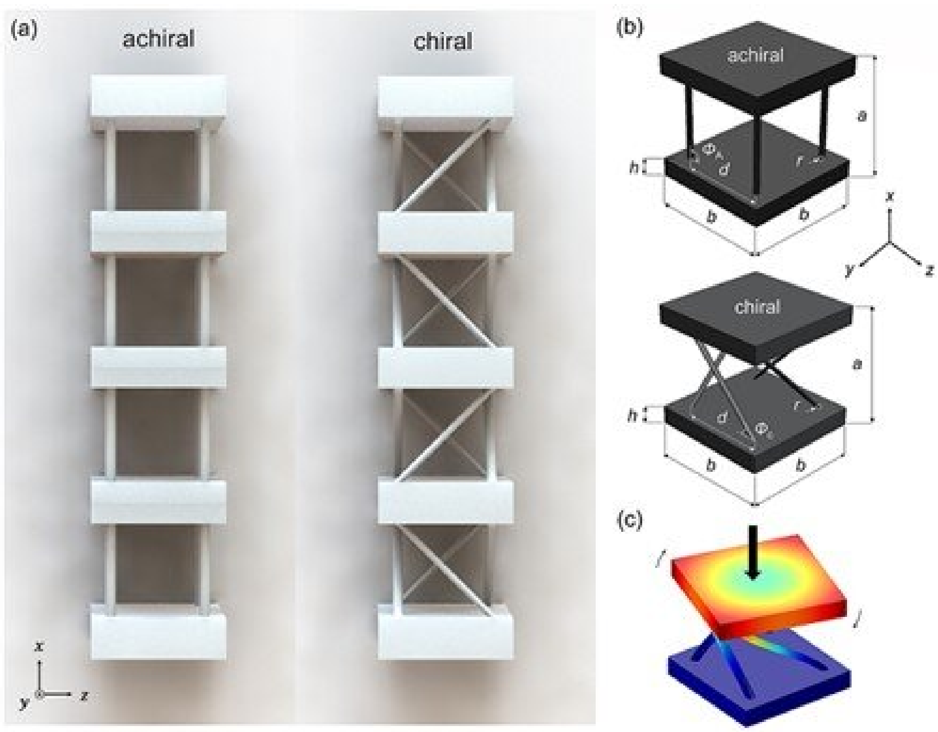
Eliminating low-frequency noise using a chiral metabeam

September 22 2022



Schematic of low-frequency vibration reduction metamaterials using a chiral structure. Credit: POSTECH

The soft whirring sound of low-frequency vibrations cannot be easily detected because it is not loud. But once detected, it can be hard to ignore. Often, residents complain of the annoyance caused by low-frequency vibrations that can be heard between adjacent apartment units in Korea.

A research team led by Professor Junsuk Rho (Department of Mechanical Engineering, Department of Chemical Engineering), Ph.D. candidate Jeonghoon Park (Department of Mechanical Engineering), and Professor Anna Lee (Department of Mechanical Engineering) at POSTECH has developed a method to completely eliminate low-frequency vibrations using a chiral structure. The chiral structure, also called mirror symmetry, is symmetrical like the left and right hands but has a unique characteristic of not overlapping.

Recently published in *Communications Physics*, the findings from this study are applicable to machinery and construction as well as for the development of vibration and noise reduction systems.

Since elastic waves of structures appear in many wave modes, suppression of all possible vibration modes has been rarely achieved. Previous studies on reducing vibrations using metamaterials—with properties that do not exist in nature—also focused only on one mode of vibration. However, such systems posed a risk of amplifying the spread of vibrations which were not originally intended.

In this study, the research team succeeded in blocking all vibration modes that spread in a specific frequency band. The researchers developed a mechanism that can effectively reduce any vibration by implementing a low-frequency complete bandgap using a chiral structure.

Professor Junsuk Rho said, "It is significant that the range of metamaterials studied in the nanometer (nm, 1 billionth of a meter) has been expanded to a size that can be used in daily life." He added, "The new system will be applicable to many fields including mechanical structures (e.g., automobiles and aircraft), buildings, and civil engineering in the future."

More information: Jeonghoon Park et al, Chiral trabeated metabeam for low-frequency multimode wave mitigation via dual-bandgap mechanism, *Communications Physics* (2022). DOI: 10.1038/s42005-022-00974-4

Provided by Pohang University of Science & Technology (POSTECH)